[0183] Actuation of a robot for grinding;

[0184] Actuation of prostheses and ortheses for human limb assistance or replacement;

[0185] Any task wherein a robot interacts with an unknown environment;

[0186] Any robot that manipulates variable-shape objects in an unknown environment;

[0187] Actuation of force augmentation robots and exoskeleton (weight lifting devices); and

[0188] Actuation of haptic interfaces (tele-presence, tele-operation, virtual reality).

[0189] It is to be understood that the invention is not limited in its application to the details of construction and parts illustrated in the accompanying drawings and described hereinabove. The invention is capable of other embodiments and of being practiced in various ways. It should also be understood that the phraseology or terminology used herein is for the purpose of description and not limitation.

[0190] Hence, although the present invention has been described hereinabove by way of illustrative embodiments thereof, these non-restrictive illustrative embodiments can be modified at will, within the scope of the appended claims, without departing from the spirit and nature of the subject invention.

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What is claimed is:

1. A mechanical differential actuator for interacting with a mechanical load comprising:

a first transducer;

a second transducer; and

a mechanical differential having three interaction ports, including a first interaction port coupled to the first transducer, a second interaction port coupled to the second transducer, and a third interaction port coupled to the load.

2. A mechanical differential actuator as recited in claim 1, wherein:

the mechanical differential actuator is characterized by an equivalent impedance Z_{eq};

the first transducer is characterized by a first mechanical impedance Z_1;

the second transducer is characterized by a second mechanical impedance Z_2; and

the second mechanical impedance Z_2 is sufficiently large compared to the first mechanical impedance Z_1 that the second mechanical impedance Z_2 does not influence significantly the equivalent mechanical impedance Z_{eq} of the mechanical differential actuator.

3. A mechanical differential actuator as recited in claim 2, wherein:

the mechanical differential is characterized by a force amplification factor K; and

$$(K+1)^2 Z_2 >> Z_1.$$

4. A mechanical differential actuator as recited in claim 3, wherein:

$$Z_{eq} \cong \frac{K^2}{(K+1)^2} Z_1.$$

5. A mechanical differential actuator as recited in claim 1, wherein the first transducer comprise a source of force.

6. A mechanical differential actuator as recited in claim 7, wherein the first transducer comprises a controller of the source of force.

7. A mechanical differential actuator as recited in claim 6, wherein the controller of the source of force comprises an element selected from the group consisting of a magneto-rheological damper, an electro-rheological damper, a magnetic particle brake, a magnetic brake based on a hysteresis effect, a stack of piezoelectric actuators acting on friction plates, a mechanism acting as a variable stiffness spring and